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(56) Documents Cited
GB 2316335 A **DE 019803083 A1**

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(54) Abstract Title
Submersible water pump with inlet filter air backwash

(57) A submersible pump apparatus 10 has a water pump impeller 16 and a fan of an air compressor 19 driven by an electric motor 14. A rotatably mounted filter has a perforated plate 29 and a turbine 32. In operation, water 38 is drawn in through the filter by the impeller 16 and directed to an outlet pipe 41. Some water travels through outlet pipe 26 and with air from the compressor outlet 24 forms a back-wash flow 40 through the filter causing it to rotate and removing debris from the filter. Alternative embodiments describe rotating water within a channel (182, fig 2) transmitting torque from the motor to the filter; compressed air driving a turbine (292, fig 3); apparatus without an electric motor where a compressed air supply (353, fig 4) turns turbines to rotate an impeller and filter before backwashing the filter; and the use of a venturi device to provide a combined air/water jet.

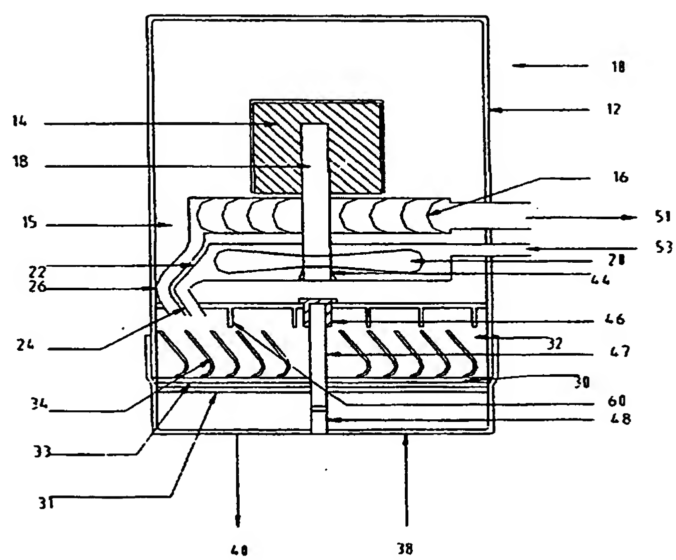

FIG 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
The claims were filed later than the filing date but within the period prescribed by Rule 25(1) of the Patents Rules 1995.
This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

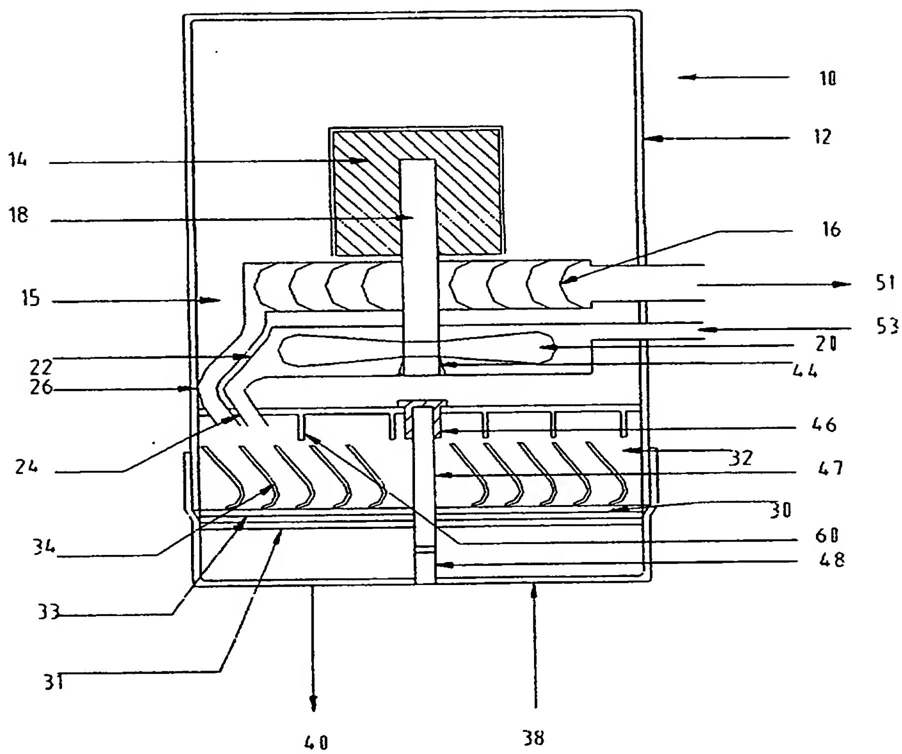

FIG 1

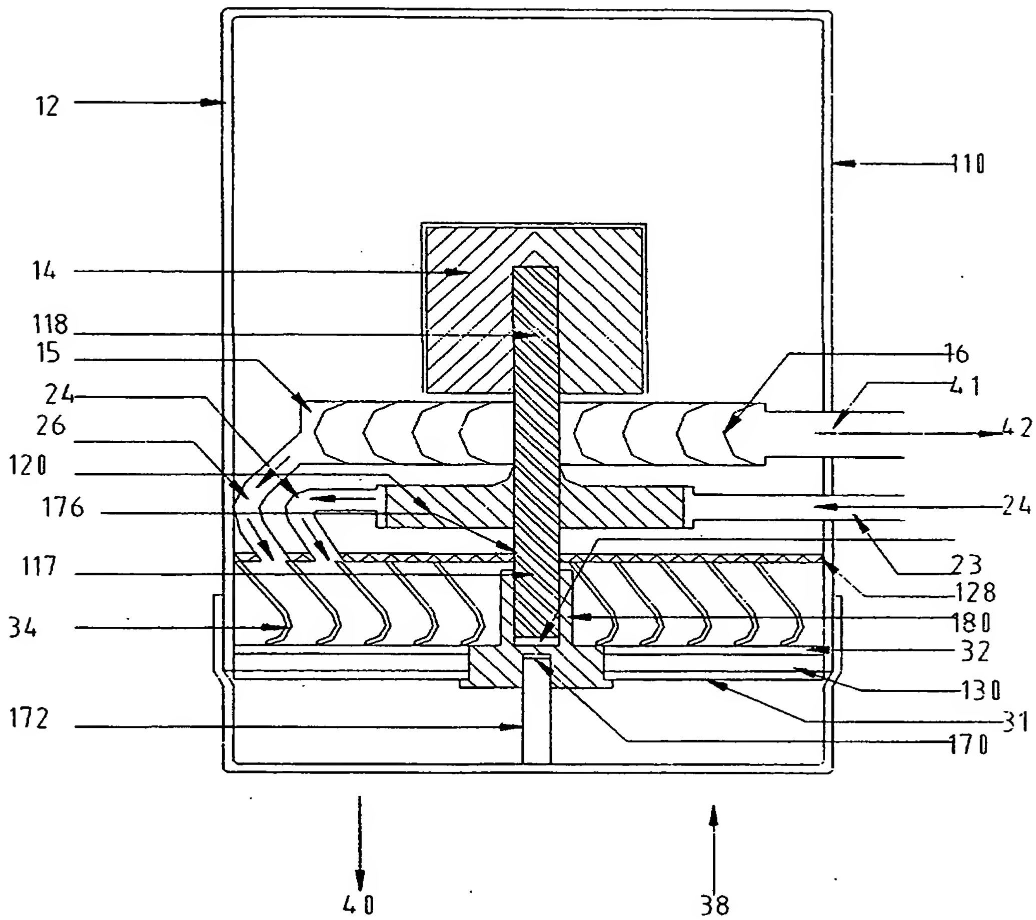
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FIG 2

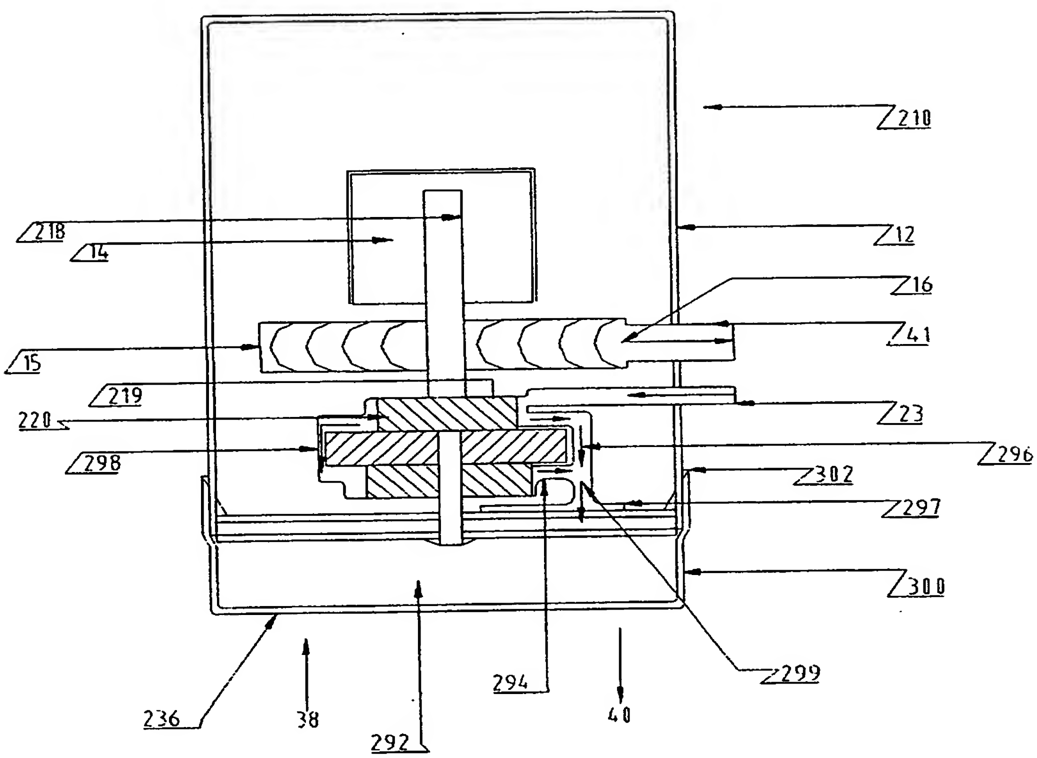
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FIG 3

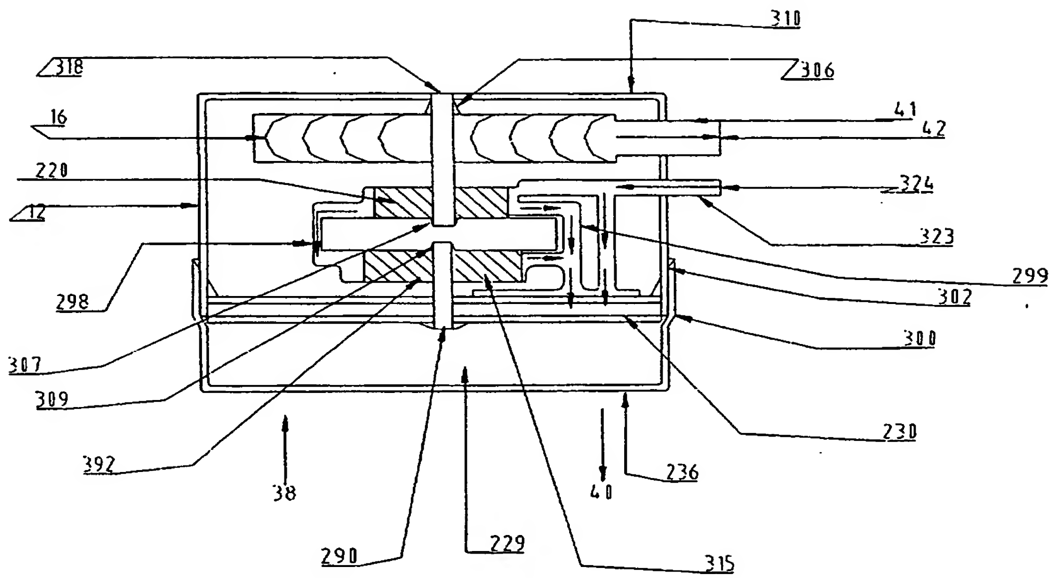
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FIG 4

WATER PUMP

The present invention relates to a self-cleaning water pump apparatus and more particularly, but not exclusively, to a self-cleaning submersible water pump apparatus.

Submersible water pumps are well known and are typically used to generate a flow of pressurised water to e.g. an ornamental water feature. A major problem with such pump apparatus is that the pump filter requires regular maintenance and cleaning. This is particularly the case where the water pump is submerged in a pond or other relatively large body of water which also includes organic matter. During the summer months when algae and weed growth are at their most vigorous, a pump filter may need cleaning once a day. In any event, even a partial fouling of the pump filter will result in a decrease in the efficiency of the pump and thus a decrease in the water feature output.

It is known to try to overcome this problem by using a back-wash of water from the pump to continuously clean the filter. However, this means that to get the same aesthetic effect from the ornamental water feature, the pump capacity must be increased, since a portion of the pumped water flow (i.e. water flow downstream of the pump) is diverted back through the filter. Additionally, this type of known arrangement provides no additional benefit to the water quality in the pond, pool or other body of water.

According to a first aspect of the present invention there is provided a self-cleaning submersible fluid pump apparatus including a drive means for operation of the pump, a filter to prevent fouling of the pump, a compressed gas source and a directing means for directing a flow of

the compressed gas through the filter such that the compressed gas cleans the filter by displacing silt or other organic or inorganic matter that would otherwise accumulate on or in the filter.

The compressed gas used in the invention is preferably compressed air.

The fluid pump apparatus is typically located in a body of fluid, which usually will be water. The apparatus may be temporarily located in the body of fluid or it may be fixed therein.

Where the fluid is water, the use of a flow of compressed gas to clean the filter according to most preferred embodiments of the invention provides at least two benefits over the known self-cleaning submersible water pumps. Firstly, the compressed gas, after being exhausted through the filter, provides an effective agitation of the water. This agitation of the water results in increased aeration, which in turn results in better water quality. Secondly, all of the water pumped by the pump may be used to supply the e.g. ornamental water feature, with none of the water pressure that has been generated by the pump needing to be diverted to pass back through the filter. Nevertheless it is possible, and therefore still within the scope of this invention, to divert a part of the pumped water flow through the filter to assist in the cleaning of the filter. In such embodiments, the amount of water that is diverted back through the filter may be significantly less than in known types of self-cleaning submersible water pumps, since the self-cleaning effect is not provided solely by this back-wash of the diverted pumped water flow.

In embodiments of the pump of the invention in which a proportion of water from the pump is diverted back to the filter to assist in its self-cleaning, this may be achieved for example by means of a divert conduit in fluid communication with the pump and having an outlet adjacent the filter, especially adjacent to the compressed gas directing means. Alternatively, a venturi device may be provided to draw fluid which has passed through the filter into the compressed gas directing means itself, so as to provide a combined fluid/gas mixture to be directed towards the filter, most advantageously in the form of a jetted spray. Thus, the use of such a venturi device leaves all of the pumped fluid exiting the pump for use in supplying whatever it is that the pump is to be used for.

The pump drive means may be an electric motor, which is preferably insulated. The electric motor is typically connected to an impeller to pump the water. This type of arrangement of an electric motor connected to an impeller is well known in the art and these components are commercially available.

Preferably, the compressed gas directing means has an output having a cross-sectional area which is smaller than the cross-sectional area of the filter. In such embodiments, one of the filter and the directing means preferably rotates relative to the other of the filter and the directing means. This arrangement enables the entire surface area of the filter to come into contact with the flow of compressed gas. This in turn increases the efficiency of the self-cleaning arrangement of the present invention. In a preferred embodiment, the directing means is fixed and the filter rotates relative to the directing means.

The water pump apparatus may include a compressor for providing the source of compressed gas. The compressor is preferably driven by the electric motor.

In certain embodiments of the invention the compressed gas source may form the drive means. In such embodiments the compressed gas typically drives a turbine which in turn drives the pump. In embodiments where the drive means is the compressed gas, the compressed gas is typically fed to the pump apparatus from a compressor located outside of the body of liquid within which the pump apparatus is typically located.

In a preferred embodiment, the filter is mounted for rotation. The filter may include a plurality of blades arranged to form a turbine such that when the flow of compressed gas passes through the filter it drives the turbine and thus causes the filter to rotate. To assist this effect the turbine blades may be provided with inverted pockets to trap gas therein. This adds buoyancy to the inverted blades on the side of the filter adjacent the directing means (and optionally fluid divert conduit, if present) and therefore lift, which together with the flow of compressed gas drives the turbine and causes the filter to rotate. Alternatively or additionally, the filter may be driven to rotate by the drive means.

The pump may include an end cap for physically protecting the filter. The end cap may act as a pre-filter which prevents relatively large foreign bodies reaching the pump filter.

In preferred embodiments of the invention as defined above just a single filter with a corresponding gas directing

means is provided to achieve its self-cleaning. However, in other embodiments of the invention it is possible for the pump to include a plurality of filters, each with preferably its own respective self-cleaning facility constituted by respective ones of a corresponding plurality of gas directing means. Such multi-filter self-cleaning arrangements may for example be useful in commercial applications for fluids to be pumped which have heavy contamination. Advantageously the filters in such pumps may have varying sizes and/or arrangements of perforations.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic sectional view through a first embodiment of the present invention;

Figure 2 is a schematic sectional view through a second embodiment of the present invention;

Figure 3 is a schematic sectional view through a third embodiment of the present invention; and

Figure 4 is a schematic sectional view through a fourth embodiment of the present invention.

Figure 1 shows a submersible water pump apparatus 10 consisting of a generally cylindrical body 12 housing an electric motor 14, a water pump 15, an air compressor 19 and a filter 29. The pump apparatus 10 is located in a body of water (not shown).

The electric motor 14 is any suitable known electric motor

commonly used in submersible water pumps and it need not be described further here. The motor 14 drives a shaft 18 to rotate. The shaft 18 extends from the motor 14 and its free end 17 is mounted for rotation within a sleeve 44. The shaft 18 carries an impeller 16 for pumping the water and a fan 20 located in the air compressor 19 for drawing in air from outside the body of water, compressing it and discharging it through a compressed air outlet 24.

The water pump 15 includes the impeller 16, a primary water outlet 41 and a secondary water outlet 26.

The air compressor 19 includes, in addition to the fan 20, an air inlet tube 23, a compression chamber 22 and the air outlet tube 24.

(As used herein, with respect to all embodiments of the pump of the invention, the terms "pipe" or "tube" are not to be construed narrowly, but are intended to encompass any suitable size and shape of conduit (whether in the form of a discrete tube or formed by a moulded-in part of the apparatus) through which the respective fluid(s)/gas(es) can pass.)

The filter 29 consists of a perforated filter plate 30 whose perforations are sized according to the required level of filtration, carried on a shaft 47. The shaft 47 is mounted for rotation at one end in a socket 46 formed in a circular baffle plate 28. The baffle plate 28 has a diameter which is the same as the internal diameter of the body 12 and it is attached to the body 12 downstream of the filter 29 and upstream of the air compressor 19. The baffle plate 28 includes a plurality of projecting elements 60 for smoothing the flow of water after it has passed through the

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filter plate 30. It will of course be appreciated by those skilled in the art that other known means of smoothing a water flow may also be provided on plate 28. The other end of shaft 47 is mounted for rotation in a second socket 48 provided in an end cap 36. The filter plate 30 includes an upstream circular planar surface 31 and a downstream circular planar surface 33. Extending from the downstream surface 33 in an axial direction is a turbine 32 consisting of a plurality of turbine blades 34. The turbine blades 34 are arranged such that a fluid flow passing through the turbine 32 towards the filter plate 30 in the direction indicated by arrow 40 (i.e. from left to right in Figure 1) causes the filter plate 30 and shaft 47 to rotate. The projecting elements 60 on the baffle plate 28 further serve to assist the directing of air from the outlet tube 24 towards and to be captured by the turbine blades 34.

The end plate 36 is releasably coupled to an upstream end portion of the pump body 12 by means of a suitable push-fit coupling (not shown). The end cap 36 includes perforations which have a greater diameter than the perforations of the filter plate 30 so that the end cap 36 acts as a pre-filter. The perforations (not shown) in end cap 36 are suitably sized to prevent larger aquatic animals such as fish and frogs entering the pump and either clogging it or being killed by it. An additional advantage of the invention however is that even if items of aquatic life are drawn into contact with and held or stranded by suction against the filter, then they may be ejected therefrom with the reverse gas flow, hopefully in a live and healthy condition.

In use, the electric motor 14 rotates the shaft 18 which in turn rotates the impeller 16 and the fan 20. Rotation of

the impeller 16 draws water into the pump apparatus in the direction of arrows 38. The water drawn in passes firstly through the end cap 36 which removes large foreign bodies from the water flow and then through filter plate 30 which removes smaller foreign bodies which are not capable of passing through the perforations (not shown) in filter plate 30. The water flow is then smoothed as it passes through the baffle plate 28 and into the pump 15. The impeller 16 pressurises the water and a major proportion of this pressurised water exits through the outlet pipe 41 in the direction shown by arrow 51 to, for example, an ornamental water feature. The remaining pressurised water exits the pump 15 through the outlet pipe 26 and forms a back-wash of water which is directed to pass back through the filter 30 in the direction indicated by the arrow 40. Thus, after the back-wash has passed through and debris has been cleaned from the filter 30, the foreign matter is deflected away from the inlet of the pump. This further helps to keep the surrounding area of the pump inlet clear of silt and debris.

In a modified version of this first embodiment the outlet pipe 26 is dispensed with or sealed off and instead there is provided a venturi device (not shown for clarity) downstream of the filter 30 at any suitable point along the length of the air outlet tube 24, preferably at or adjacent its open end so as to deliver into the air outlet tube 24 an amount of water that has passed through the filter 30. The venturi device may be of any suitable known type, for example of the nature of that known for use in engine carburettors, such as in the form of a hole in the wall of the outlet tube 24. The venturi device provides a combined water/air jet exiting the outlet tube 24 for achieving a spray effect against the filter 30.

Rotation of the shaft 18 also rotates the fan 20 which draws air into the pump apparatus in the direction indicated by arrow 53 from outside of the body of water through inlet pipe. The fan 20 compresses the air which is drawn into the compression chamber 22. It is then exhausted through the outlet pipe 24, the end portion of which lies adjacent to the outlet pipe 26 so that the pressurised air flow also passes through the filter 29 in a direction indicated by the arrow 40. The flow of compressed air and pressurised water passing through the turbine 32 causes rotation of the filter plate 30 via rotation of shaft 47 within sockets 46 and 48. The rotation of the filter plate 30 relative to the outlet pipes 24 and 26 results in substantially the entire surface area of filter plate 30 being subjected to the flow of compressed gas and pressurised water. The flow of compressed air and pressurised water passing back through the filter in direction of arrow 40 removes the foreign matter which had accumulated on the upstream surface 31 of the filter plate 30, the foreign matter is carried by the flow of compressed gas and pressurised water through the end cap 36 and away from the pump apparatus 10.

A second embodiment of the present invention is shown in Figure 2. Features which are common to the first embodiment are indicated by the same reference numerals as used in the description of the first embodiment. The submersible water pump apparatus 110 shown in Figure 2 includes a pump body 12 housing the electric motor 14 and the water pump 15 as described above with regard to the first embodiment. However, in the second embodiment, the shaft 118 driven by the motor 14 includes a plurality of longitudinal fins 174 (described in more detail below). The fins 174 preferably extend substantially the whole length of the shaft 118 as

shown, although in modified embodiments they may not do so, ie. extend over only a portion of the length of the shaft 118.

The compressor 119 is a rotary compressor including a rotor 120 carried on a shaft 118. The air is drawn into a compression chamber 122, compressed by rotation of the rotor 120 and exhausted through the outlet pipe 24.

The shaft 118 passes through an aperture 176 in a baffle plate 128. The free end 117 of the shaft 118 is located within a sleeve 180 which is also preferably internally ribbed or splined which extends axially from a central portion 170 of the filter 129. The sleeve 180 and the end 117 of shaft 118 define therebetween a small channel 182 which is filled with water. When the shaft 118 is rotated by the electric motor 14, the ribs 174 cause a corresponding rotation of the water within the channel 182. The rotation of the water in channel 182 generates a torque which acts on the sleeve 180. The central portion 170 of the filter 129 includes a cylindrical recess 184 in its upstream surface into which is received an end portion of a spigot 172 which extends from an end cap 136. The filter 129 is mounted for rotation about the spigot 172 and the shaft 118, with the water in the channel 182 and the water between the recess 184 and the spigot 172 acting as respective bearings.

In this second embodiment, the filter 129 has three forces acting on it and causing it to rotate. The first is torque generated by the turbine from the flow of compressed air and pressurised water passing through it. The second force is the torque imparted to the sleeve 180 from the water which is caused to rotate in the channel 182 by the fins

174 of the shaft 118. The third force is the torque exerted by means of the buoyancy and lift of the gas captured in the turbine blades 34.

Figure 3 shows a third embodiment of the present invention. In this third embodiment, the filter 229 comprises a filter plate 230 connected to a turbine 292 via a shaft 290 which is mounted for rotation.

The compressor 219 consists of a similar arrangement to that described above with respect to the second embodiment. However, in this embodiment, the compressed air downstream of the compressor rotor 220 is exhausted through a first air outlet 298 and a second air outlet 296. The compressed air from the first air outlet 298 is directed such that it drives the turbine 292. Exhaust pipe 294, which takes the compressed gas after it is has passed through the compressor is joined with exit pipe 296 so that the two flows of compressed gas are brought together. The combined flows of compressed gas are then carried by joint pipe 299 to nozzle 297 which is arranged so that the compressed gas exiting the nozzle 297 passes through the filter plate 230 in the direction indicated by arrow 40.

An end plate 236 is releasably attached to the body 12 of the pump assembly 210. The end cap 236 includes a free end in the form of a cylindrical portion 300 whose interior diameter is substantially the same as the exterior diameter of the body 12. A rubber O-ring 302 is located in a circumferential slot (not shown) in the inwardly facing surface of the cylindrical portion 300. When the end cap 236 is positioned on the body 12, the O-ring 302 forces the cylindrical portion 300 radially outwards and the resultant inwardly directed force exerted by the resilient

cylindrical portion 300 acting against the O-ring seal 302 resists removal of the end cap 236. The above described push-fit coupling is well known to those skilled in the art.

A fourth embodiment of the present invention is shown in figure 4. In this fourth embodiment, the pump apparatus 310 does not include an electric motor. Instead, the pump 315 is driven by a compressed air source 308 located outside the body of water.

Compressed air from compressor 308 is pumped in a direction indicated by arrow 353 to the pump apparatus 310 via compressed air inlet pipe 323. Pipe 323 has a branch pipe 313 extending from it. Compressed air exits from pipe 323 into a first turbine 315 which is carried on a shaft 318. The shaft 318 carries near its opposite end the water=pump impeller 16. The shaft 318 is mounted for rotation in respective sockets 306,307. The first turbine 315 is in communication with a second turbine 392 via a pipe 298. Compressed air exhausted from the first turbine 220 passes through a first exhaust pipe 298 or a second exhaust pipe 296. The compressed gas exhausted from the first exhaust pipe 298 passes through a second turbine 392 and then to a third exhaust pipe 294. The second and third exhaust pipe 296,294 are connected to each other so that the respective compressed gas flows from each of these pipes are combined. The combined gas flow is carried to a nozzle 397 by an outlet pipe 299. The branch pipe 313 also carries a compressed air flow to the nozzle 397. The nozzle 397 has an identical arrangement with respect to the filter 229 as the nozzle 297 described above. The filter 229 and the end cap 236 also are as described above.

In this fourth embodiment, the water pump is driven by compressed air which, of course, alleviates the need to have an electric motor submerged under water. This also results in a much more compact pump apparatus which can be submerged in a relatively small body of water.

These preferred embodiments have been described by way of example only and it will be apparent to those skilled in the art that many alterations can be made that are still within the scope of the invention.

CLAIMS

1. A submersible fluid pump apparatus including a drive means for operation of the pump apparatus, a filter to prevent fouling of the pump apparatus, a compressed gas source and a directing means for directing a flow of the compressed gas through the filter such that the compressed gas imparts a cleaning action to the filter.

2. A submersible fluid pump apparatus according to claim 1 wherein the compressed gas is compressed air.

3. A submersible fluid pump apparatus according to claim 1 or claim 2 wherein the drive means is an electric motor.

4. A submersible fluid pump apparatus according to any preceding claim wherein the pump includes a compressor for providing the source of compressed gas.

5. A submersible fluid pump apparatus according to claim 1 or claim 2 wherein the drive means is a

compressed gas-driven turbine.

6. A submersible fluid pump apparatus according to any preceding claim wherein the compressed gas directing means includes an output having a cross-sectional area smaller than the cross-sectional area of the filter and wherein one of the filter and the directing means rotates relative to the other of the filter and the directing means.

7. A submersible fluid pump apparatus according to claim 6 wherein the gas directing means is fixed and the filter rotates relative to the directing means.

8. A submersible fluid pump apparatus according to claim 7 wherein the filter is mounted for rotation and includes a plurality of blades arranged to form a turbine such that the flow of compressed gas passing through the filter drives the turbine and causes the filter to rotate.

9. A submersible fluid pump apparatus according to claim 7 wherein the filter is driven to rotate by the pump drive means.

10. A submersible fluid pump apparatus according to

any preceding claim wherein the pump includes a second directing means for directing a flow of the fluid pressurised by the pump through the filter to impart an additional cleaning action to the filter.

11. A submersible fluid pump apparatus according to any preceding claim wherein the pump apparatus further includes an end cap for physically protecting the filter.

12. A submersible fluid pump apparatus substantially as herein described in any one embodiment with reference to the accompanying drawings.

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Application No: GB 9921995.8
Claims searched: 1-11
Examiner: Terence Newhouse
Date of search: 9 April 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B1D(DNCH,DNCK,DNRA); F1C(CA,CFWB)

Int Cl (Ed.7): B01D 29/00 29/66 29/68; F04D 13/08 29/70

Other: ONLINE: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2316335 A	(MICHAEL BAKEY), see particularly page 4 lines 5-21 and page 6 lines 6-14	1-3,6-9,11
Y	DE 19803083 A1	(KNECHT FILTERWERKE), see also WPI Abstract Accession No. 1999-420188 [36] and fig 1 noting directing means 14 for compressed air	1-3,6-9,11

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		

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